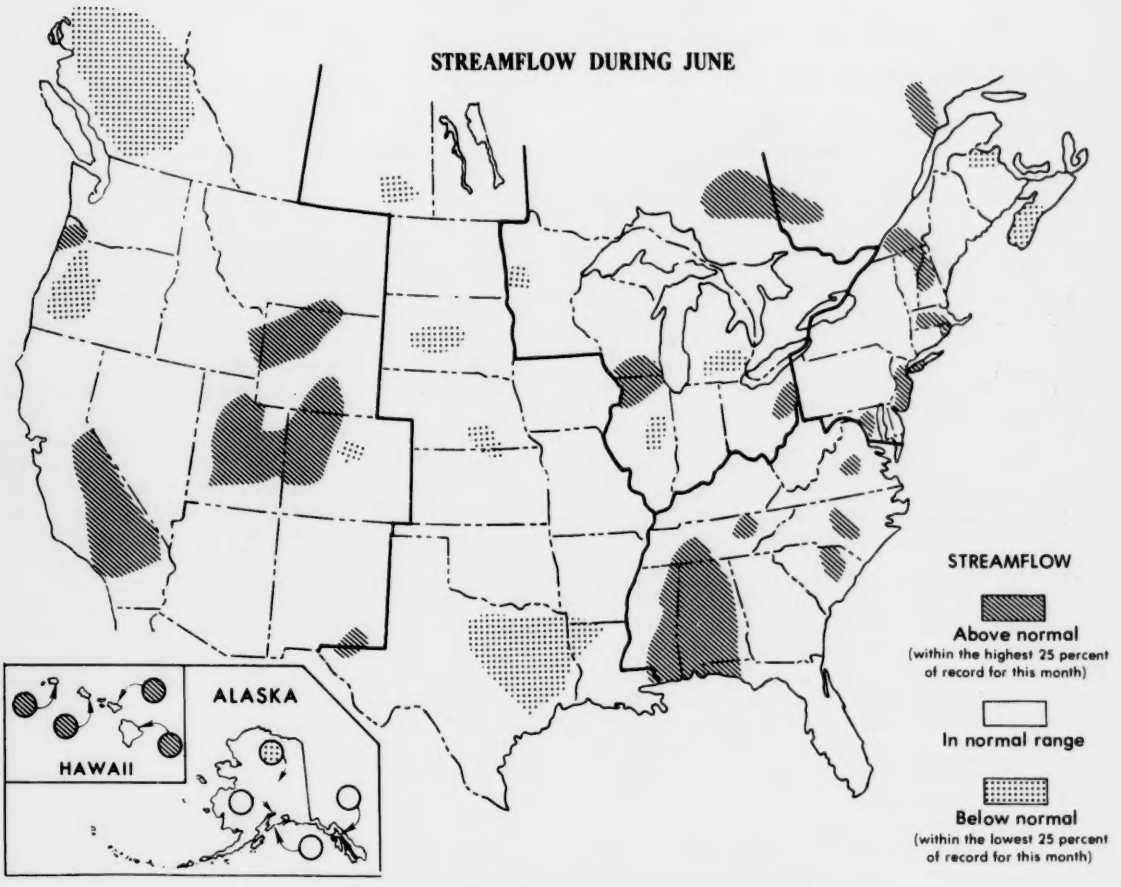
WATER RESOURCES REVIEW for JUNE 1978

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH



STREAMFLOW AND GROUND-WATER CONDITIONS

Streamflow generally decreased seasonally in Arizona, New Mexico, and Oregon, and in most eastern and central States and Provinces; was variable in California, Hawaii, and Washington, and generally increased elsewhere, including Alberta, British Columbia, and Alaska.

Flooding occurred in parts of Indiana, Minnesota, Missouri, Nebraska, Ohio, Texas, and Wisconsin.

Above-normal streamflow persisted in part of Quebec, and in parts of many northeastern, southeastern, and north-central States, and in California and Oregon. Monthly mean flows were highest of record in part of Wyoming, and were highest for June in part of Hawaii.

Flows remained below the normal range in parts of British Columbia, Saskatchewan, Alaska, Texas and Oregon. Monthly and daily mean discharges were lowest for June in part of Alaska.

Ground-water levels generally declined seasonally in the Northeast, but levels continued above average in much of the region. Levels declined in the Southeast, with mixed trends in some States; levels were above and below average in the region. Declining levels prevailed for the most part in the Western Great Lakes and Midcontinent regions; levels were mostly below average, but were above in Nebraska and most of Iowa and average in Ohio. Levels declined and were mostly below average in the West, with mixed trends in some States, but rose and were average in Montana.

New June high levels occurred in southern California and Virginia. New lows for June were recorded in Arizona, Arkansas, Georgia, Idaho, Kansas, Louisiana, Nevada, New Mexico, and Tennessee. A new alltime low was reached in Idaho, and two new alltime lows occurred in Texas.

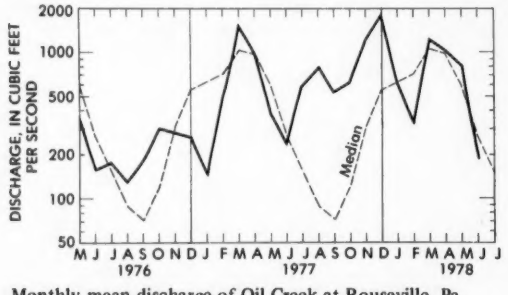
NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New Jersey, New York, Pennsylvania, and the New England States]

Streamflow decreased seasonally throughout the region. Monthly mean flows remained in the above-normal range in parts of Quebec, Maryland, New Hampshire, New Jersey, New York, and Rhode Island, and increased into that range in parts of Massachusetts. Flows decreased into the below-normal range in parts of the Atlantic Provinces.

Ground-water levels generally declined seasonally. Levels remained above average in many areas.

In northwestern Pennsylvania, where monthly mean flow in Oil Creek at Rouseville was in the above-normal range in May, flow decreased sharply to only 69 percent of median but was within the normal range. (See graph.) Elsewhere in the State, streamflow decreased seasonally, was near or above median, and within the normal range.



Monthly mean discharge of Oil Creek at Rouseville, Pa. (Drainage area, 300 sq mi; 777 sq km)

In central Maryland, streamflow decreased seasonally at Seneca Creek at Dawsonville but remained in the above-normal range at twice the median flow. In the Choptank River basin in eastern Maryland and the adjacent area of Delaware, monthly mean flow at the index station near Greensboro, Md. decreased from the above-normal range in May and was in the normal range during June.

In New Jersey, streamflow decreased seasonally but high carryover flow from May held monthly mean discharges in the above-normal range for the 2d consecutive month at the two index stations, South Branch Raritan River near High Bridge and Great Egg Harbor River at Folsom, in northern and southern parts of the State, respectively.

In New York, streamflow decreased seasonally throughout the State and most monthly mean flows at the index stations were within the normal range. On Long Island, however, high carryover flow at the index station, Massapequa Creek at Massapequa, held monthly mean flow in the above-normal range for the 2d consecutive month.

In adjacent Connecticut, where monthly and daily mean flows in Salmon River near East Hampton, in the southeastern part of the State, were highest of record for the month during May, flow decreased sharply in June and was in the normal range. Elsewhere in the State, monthly mean flows were generally above median but within the normal range.

In Rhode Island, monthly mean discharge at the index station, Branch River at Forestdale remained in the above-normal range for the 3d consecutive month and above the monthly median flow for the 10th consecutive month.

In Massachusetts, where streamflow during May was in the normal range and slightly less than median, the seasonal decrease in flow was only 16 percent compared to the normal decrease of 46 percent at Ware River at Coldbrook and the resulting monthly mean flow was above the normal range. In adjacent New Hampshire, monthly mean discharge at the index station, Pemigewasset River at Plymouth, remained in the above-normal range at over 2 times the June median flow.

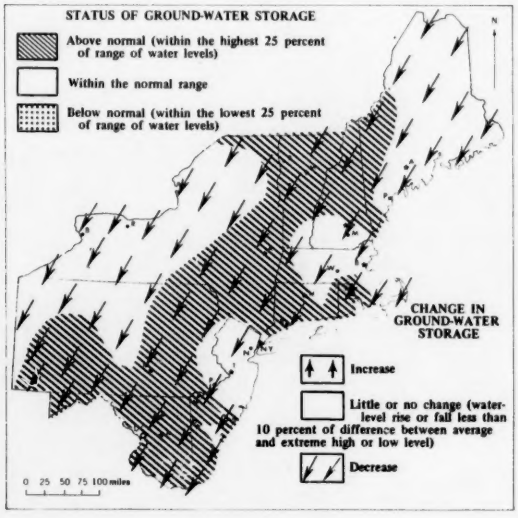
Monthly mean flow at the index stations in Maine and Vermont were all above median but within the normal range.

In southern Nova Scotia, monthly mean discharge at the index station, LaHave River at West Northfield, was only 53 percent of median and below the normal range. In northern New Brunswick, where mean flow in Upsalquitch River at Upsalquitch was above the normal range and 156 percent of median in May, flow decreased sharply and was below the normal range in June at only 64 percent of median. Elsewhere in the Atlantic Provinces, mean flows were near or slightly below median, but within the normal range.

In eastern Quebec, high carryover flow from May held monthly mean discharge in Outardes River at Outardes Falls in the above-normal range for the 3d consecutive month. In the extreme southern part of the Province, south of the St. Lawrence River, the seasonal decline in streamflow that began in May at St. Francois River at Hemming Falls, continued in June and mean flow at that site was above the normal range. In the western part of the Province, monthly mean discharge in Harricana River at Amos decreased seasonally to 116 percent of median but flow at that site was above the normal range. Elsewhere in the Province, monthly mean flows at index stations were near or slightly below median but within the normal range.

CONTENTS

Ground-water levels generally declined seasonally, except for higher levels in some wells in New Jersey. Above-average levels continued to prevail in many parts of the region, including most of Rhode Island, Connecticut, Delaware, Maryland, and southeastern New York State. (See map.)



Map shows ground-water storage near end of June and change in ground-water storage from end of May to end of June.

SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

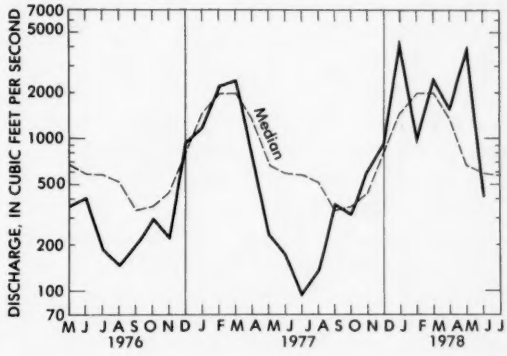
Streamflow decreased seasonally at all index stations in the region except one. Monthly mean flows remained in the above-normal range in Alabama, and in parts of Florida, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia.

Ground-water levels generally declined in Kentucky, Virginia, Tennessee, North Carolina, Mississippi, and Alabama, and showed mixed trends elsewhere in the region. Levels were above average in Virginia and North Carolina, and in most areas in West Virginia and Kentucky, but below average in Georgia, Mississippi, and Florida. New lows for June occurred in Tennessee and Georgia, and a new high for June was recorded in Virginia.

In northeastern Mississippi, where flooding occurred in May along Tombigbee River and the monthly mean discharge of Tombigbee River at Columbus was highest of record for that month, mean flow decreased seasonally at that station but remained in the above-normal range and was 3½ times the June median flow. In the southeastern part of the State, mean discharge of Pascagoula River at Merrill also remained above the normal range and was 2½ times the June median.

In adjacent Alabama, where monthly mean discharges in May were above the normal range at all index stations, mean discharges decreased seasonally in June but the high carryover flows from May, augmented by increased runoff from rains early in June, held monthly mean flows in the above-normal range in all parts of the State.

In North Carolina, where flooding occurred in May along streams in the eastern Piedmont and Coastal Plain and where monthly mean flow of Neuse River near Clayton was highest for the month since records began in July 1927, mean flow at that station decreased seasonally and was in the normal range for June. (See graph.) In the adjacent basin of Cape Fear River, mean



Monthly mean discharge of Neuse River near Clayton, N.C. (Drainage area, 1,140 sq mi; 2,950 sq km)

flow at William O. Huske Lock and Dam near Tarheel also decreased seasonally but remained in the above-normal range. Rapid runoff from very intense rainfall, reported to have been 5 to 6 inches in one hour, resulted in flooding in the northeastern part of the city of Charlotte on June 22, in south-central North Carolina.

In eastern South Carolina, monthly mean flow of Lynches River at Effingham decreased seasonally but remained above the normal range. In the adjacent basin of Pee Dee River, where monthly mean discharge at Peedee was in the above-normal range in May, flow decreased sharply during June and the monthly mean was in the normal range and slightly greater than median.

In Tennessee, where May flows increased unseasonally and were above the normal range throughout the State, monthly mean discharges decreased seasonally in June and were in the normal range in French Broad River

below Douglas Dam and in Harpeth River near Kingston Springs, but remained in the above-normal range in Buffalo River near Lobelville and in Emory River at Oakdale.

In adjacent Kentucky, where monthly mean flows also increased in May, contrary to the normal seasonal patterns of decreasing flows, and were above the normal range, mean discharges in June were seasonally lower, were within the normal range, and were well below the median flows for the month.

In northern West Virginia, where mean flow of Potomac River at Paw Paw during May was highest for the month since records began in October 1938, monthly mean discharge in June decreased sharply, was in the normal range, and was only 71 percent of median. Elsewhere in the State, mean flows also decreased seasonally and were in the normal range and were less than median.

In central Virginia, monthly mean flow of Slate River near Arvonia remained above the normal range as a result of high carryover flow from May, augmented by increased runoff from rains early in June. In other parts of the State, monthly mean flows decreased seasonally, were greater than median, but were in the normal range.

In Georgia, where monthly mean discharges were above the normal range in all parts of the State in May, flows decreased seasonally and were in the normal range. Mean discharges in the central part of the State generally were less than median while those in northern and southern basins were greater than the median discharges for June.

In extreme northwestern Florida, where mean flow of Shoal River near Crestview in May was highest for the month since record began in July 1938, monthly mean discharge decreased seasonally but was 2½ times the median flow for June and remained above the normal range for the 6th consecutive month. In the west-central part of the State, mean flow of Peace River at Arcadia increased seasonally and was in the normal range. Elsewhere in the State, flows decreased seasonally, were greater than median, and were in the normal range.

Ground-water levels in West Virginia rose in the northern and eastern panhandles and declined elsewhere. Levels were above average in the eastern panhandle and along the northern boundary, and in a few central counties; levels were below average elsewhere. Levels in Kentucky declined seasonally but were above average in most areas. In Virginia, levels declined in the three key wells but continued above average; despite a decline of more than 1½ feet, the level in the Pilcher well near Petersburg was at a new high for June in 38 years of record. In western Tennessee, the artesian level in the key well in the "500-foot sand" near Memphis declined slightly and was at a new low for June; the level continued more than 15 feet below average. In North Carolina, levels rose in the Coastal Plain and eastern Piedmont, and declined in the western Piedmont and in the mountains; levels were above average statewide. In Mississippi, levels declined statewide; levels in some wells in the heavily pumped Sparta Sand in the Jackson area reached new lows for June. In Alabama, levels generally declined; the level in the well in the Eutaw Formation in Montgomery declined about 2½ feet but continued above average. In Georgia, levels in the Piedmont ranged from slightly higher to 2 feet lower than those for the end of May. In the principal artesian aquifer in the coastal counties, levels generally declined. In the southwest they were 2 to 8 feet lower. In the Savannah area, the level in the Cockspur Island well declined 1 foot, continued below average, and reached a new low for June in 22 years of record. Levels in southwestern Georgia declined 2 to 8 feet but ranged up to 14 feet above those of a year ago. Levels generally declined in central peninsular Florida, but rose in the extreme northwest part of the State and in west-central Polk County. Levels rose and were mostly above average in southeastern Florida.

WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

Streamflow generally decreased seasonally in Ontario, Illinois, Indiana, Michigan, and Ohio and was variable in Minnesota and Wisconsin. Monthly mean flows remained above the normal range in parts of Illinois and Ohio and increased into that range in part of Ontario. Flows decreased into the below-normal range in parts of Illinois, Michigan and Minnesota. Flooding occurred in Indiana, Minnesota, Ohio, and Wisconsin.

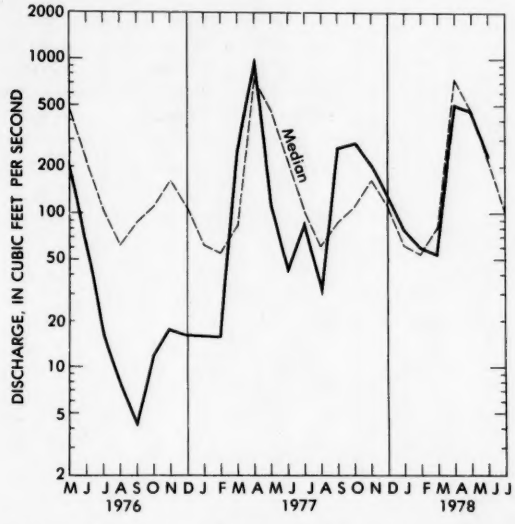
Ground-water levels generally declined in the region except in the Upper Peninsula of Michigan. Levels were about average in Ohio, and mostly below average in Michigan and in northeastern Indiana.

Rapid runoff from intense rainfall on June 25, in and near Indianapolis, Indiana, resulted in flooding that was confined mostly to small streams and was reportedly the highest in 20 years at several sites. Flood damages were heaviest in urban areas of Indianapolis, and confined to roads, culverts, and bridges in the rural areas. The resulting peak discharge at the gaging station, Crooked Creek at Indianapolis (drainage area, 17.9 square miles) was 5,500 cfs, the greatest discharge observed there since

records began in 1969 and equivalent to a 40-year flood at that site. Also in Indianapolis, the peak flow of Eagle Creek (drainage area, 174 square miles) on June 26 was 11,700 cfs and was equal to a 25-year flood. Other peak discharges were generally on the order of a 10-year flood at their respective sites. Elsewhere in Indiana, monthly mean flows at the index stations decreased seasonally, were near or below median, and were in the normal range.

In central Ohio, flash flooding occurred near Buckeye Lake on June 17 as a result of runoff from rainfall in excess of 7 inches. Minor property damage occurred as a result of flooding in the area. Elsewhere in the State, monthly mean flows decreased seasonally and were in the normal range except in the northeastern part of the State where mean discharge of Little Beaver Creek near East Liverpool remained in the above-normal range for the 2d consecutive month.

In Michigan's Upper Peninsula, monthly mean flow of Sturgeon River near Sidnaw continued to decrease seasonally, was slightly greater than median, and remained in the normal range. (See graph.) In the southern part of the State, mean flow of Red Cedar River at East Lansing decreased sharply to only 46 percent of median and was below the normal range.



Monthly mean discharge of Sturgeon River near Sidnaw, Mich. (Drainage area, 171 sq mi; 443 sq km)

In eastern Ontario, the seasonal decrease in the monthly mean discharge at Missinaibi River at Mattice was less than normal and the resulting mean flow was in the above-normal range. Elsewhere in the Province, monthly mean discharges were generally greater than median but were within the normal range at English River at Umfreville and Saugeen River near Port Elgin.

In northwestern Minnesota, where monthly mean flow in April in Buffalo River near Dilworth was highest of record for the month, flow continued to decrease seasonally in May and June and the monthly mean flow of 61.5 cfs during June was only 43 percent of median and below the normal range. A localized thunderstorm dropped heavy rain at Albert Lea, in the southwestern part of the State, on June 15 and caused an estimated $25,000 damages in road washouts and flooded basements. Elsewhere in the State, monthly mean flows at the index stations were generally above median but within the normal range.

In Wisconsin, streamflow generally decreased seasonally in the eastern part of the State and increased elsewhere, but monthly mean discharges at all index stations were in the normal range. In the southern part of the State, runoff from intense rains near midmonth caused peak discharges on streams in that area that were generally equal to or less than a 5-year flood. An exception was the peak discharge of 12,000 cfs on June 17 at the gaging station, Platte River near Rockville (drainage area, 142 square miles) where the recurrence interval for that flood was slightly greater than a 10-year event.

In the Rock River basin in northern Illinois, monthly mean discharge of Pecatonica River at Freeport increased seasonally as a result of runoff from heavy rains near midmonth and remained in the above-normal range for the 2d consecutive month at over twice the median flow. Downstream, on the Rock River at Joslin, monthly mean flow decreased seasonally but remained in the above-normal range. In the central part of the State, monthly mean discharge of Sangamon River at Monticello decreased sharply to only 34 percent of median and was below the normal range.

Ground-water levels in shallow water-table wells in Minnesota declined and continued below average in the northern part of the State, and declined but continued above average in the south. In the Minneapolis-St. Paul area, artesian levels declined in wells tapping the Prairie du Chien-Jordan aquifer and the deeper Mt. Simon-Hinckley aquifer; levels in both continued below average. Levels in Michigan rose in the Upper Peninsula but declined elsewhere; they were below average in most parts of the State. In Illinois, the level in the shallow index well in glacial drift at Princeton, in Bureau County, declined nearly 3 feet and continued above average. Levels in Indiana continued fairly steady except in the northeast, where they declined and were considerably below average at month's end. Levels declined

(Continued on page 7.)

SELECTED DATA FOR THE GREAT LAKES, GREAT SALT LAKE, AND OTHER HYDROLOGIC SITES

GREAT LAKES LEVELS

Water levels are expressed as elevations in feet above International Great Lakes Datum 1955

(Data furnished by National Ocean Survey, NOAA, via U.S. Army Corps of Engineers office in Detroit. To convert data to elevations above mean sea level datum of 1929, add the following values: Superior, 0.96; Michigan-Huron, 1.20; St. Clair, 1.24; Erie, 1.57; Ontario, 1.22.)

Lake	June 30, 1978	Monthly mean, June		June		
		1978	1977	Average 1900–75	Maximum (year)	Minimum (year)
Superior (Marquette, Mich.)	600.70	600.61	600.25	600.67	601.64 (1951)	598.63 (1926)
Michigan and Huron (Harbor Beach, Mich.)	578.98	578.93	578.55	578.54	580.89 (1973)	575.90 (1969)
St. Clair (St. Clair Shores, Mich.)	574.75	574.76	574.29	573.77	576.23 (1973)	571.74 (1934)
Erie (Cleveland, Ohio)	572.16	572.25	571.70	570.96	573.51 (1973)	568.46 (1934)
Ontario (Oswego, N.Y.)	246.08	246.30	244.98	245.55	248.06 (1952)	242.91 (1935)

GREAT SALT LAKE

Alltime high: 4,211.6 (1873). Alltime low: 4,191.35 (October 1963).	June 30, 1978	June 30, 1977	Reference period 1904–77		
			June average, 1904–77	June maximum (year)	June minimum (year)
Elevation in feet above mean sea level:	4,199.95	4,200.35	4,198.9	4,204.8 (1923)	4,192.75 (1963)

LAKE CHAMPLAIN, AT ROUSES POINT, N.Y.

Alltime high (1827–1975): 102.1 (1869). Alltime low (1939–1975): 92.17 (1941).	June 29, 1978	June 30, 1977	Reference period 1939–75		
			June average, 1939–75	June max. daily (year)	June min. daily (year)
Elevation in feet above mean sea level:	97.32	95.64	96.88	101.02 (1947)	94.35 (1965)

FLORIDA

Site		June 1978		May 1978	June 1977
		Discharge in cfs	Percent of normal	Discharge in cfs	Discharge in cfs
Silver Springs near Ocala (northern Florida)		830	109	870	675
Miami Canal at Miami (southeastern Florida)		284	84	235	461
Tamiami Canal outlets, 40-mile bend to Monroe		230	237	71	12

(Continued from page 5.)
in the key wells in central and northeastern Ohio, but were about average in both areas.

MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

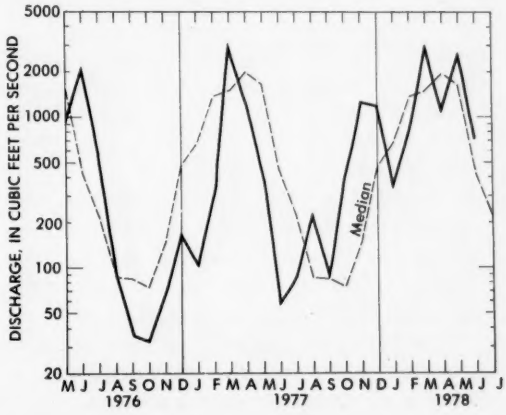
Streamflow generally decreased in Manitoba, Saskatchewan, Arkansas, Louisiana, Missouri, Nebraska, North Dakota, South Dakota, and Texas, and generally increased in Iowa, Kansas, and Oklahoma. Decreasing flows in parts of Manitoba, Iowa, Kansas, North Dakota, and South Dakota, and increasing flows in parts of Louisiana, Oklahoma, and Texas, were contrary to the normal seasonal patterns of flow in those areas. Flows remained in the below-normal range in parts of Saskatchewan and Texas, and decreased into that range in parts of Kansas, Louisiana, and South Dakota. Flooding occurred in parts of Missouri, Nebraska, and Texas.

Ground-water levels declined in North Dakota, Nebraska, Kansas, and Arkansas, and showed mixed trends elsewhere in the region. Levels were above average in Nebraska, below average in Arkansas, and mixed elsewhere. New lows for June occurred in Kansas, Arkansas, and Louisiana, and two alltime lows in Texas.

In western Texas, monthly mean flows were above the normal range in Devils, San Saba, and South Concho River basins. In the south-central part of the State, mean flow of Guadalupe River near Spring Branch increased, contrary to the normal seasonal pattern of decreasing flow, was greater than the median for the first time in 5 months, and was in the normal range. In eastern Texas, monthly mean flow of Neches River near Rockland continued to decrease seasonally and remained below the normal range for the 4th consecutive month. Also in eastern Texas, monthly mean flow of North Bosque River near Clifton decreased and was below the normal range for the 5th time in the past 7 months. Cumulative runoff at that index station, for the first 9 months of 1978 water year, was only 11 percent of the median cumulative runoff. In the southeastern part of the State, minor flooding occurred in the Houston area early in the month.

In central Louisiana, monthly mean flow of Red River at Alexandria remained in the below-normal range. Cumulative runoff at that station for the past 12 months was only 44 percent of median. In northwestern Louisiana, monthly mean flow of Saline Bayou near Lucky decreased sharply, from 3½ times median in May to ½ the median flow in June, and was below the normal range. In the southern part of the State, mean flow in Calcasieu River near Oberlin increased sharply, contrary to the normal seasonal pattern of decreasing flow, and was 2 times the June median discharge.

In Arkansas, monthly mean flows decreased seasonally, remained within the normal range, and were greater than median. For example, mean flow of Buffalo River near St. Joe, in the northern part of the State, decreased from 2,508 cfs in May (154 percent of median) to 719 cfs in June (164 percent of median) and remained in the normal range. (See graph.)



Monthly mean discharge of Buffalo River near St. Joe, Ark. (Drainage area, 829 sq mi; 2,147 sq km)

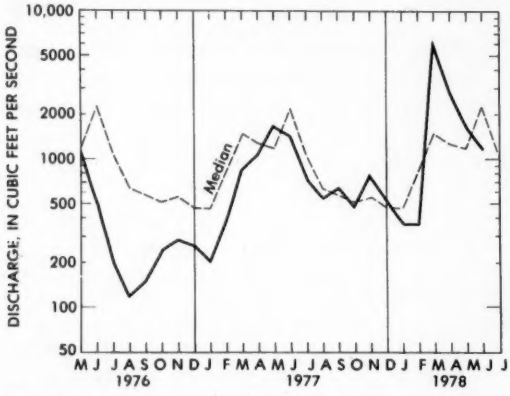
In Oklahoma, where flooding occurred as a result of runoff from intense thunderstorms near the end of May, and where rains were reported to have continued through the first half of June, the high carryover flow from May, augmented by increased runoff in June, which was contrary to the normal seasonal pattern of decreasing flow, held monthly mean discharges above median throughout the State. Monthly mean flow at the index station, Washita River near Durwood, was almost 3 times the median discharge for June. Reservoir storage generally was above normal.

In Little Blue River basin in northeastern Kansas and the adjacent area of southeastern Nebraska, where mean flow as measured at Barnes, Kansas was above the normal range in March, April, and May, mean flow decreased sharply in June and was below the normal range and only 36 percent of median. In northwestern Kansas, mean flow of Saline River near Russell increased seasonally and remained within the normal range but was only about ½ the median discharge for June. In the southern part of the State, monthly mean discharge of Arkansas River at Arkansas City also increased seasonally, remained in the normal range, and was slightly greater than normal.

In Missouri, where flooding occurred in the western and north-central parts of the State in May, flooding along Salt River, in northeastern Missouri, was reported to have occurred June 23, 24 as a result of rapid runoff from a localized thunderstorm. In the central part of the State, mean flow of Gasconade River at Jerome decreased sharply to 57 percent of median. In extreme northwestern Missouri, where monthly mean discharge of Grand River near Gallatin was in the above-normal range in March, April, and May, flow also decreased sharply, was in the normal range, and was slightly less than median.

In Iowa, the streamflow pattern was quite variable during June. For example, in the southwestern part of the State, mean flow of Nishnabotna River above Hamburg decreased, contrary to the normal seasonal pattern of increasing flow, and was only 70 percent of median, following 3 consecutive months of flow in the above-normal range and 2 to 4 times median. In north-central and northeastern Iowa, runoff from intense rains June 14-17 resulted in sharp increases in flow in the Iowa, Winnebago, and Cedar River basins. In central Iowa, mean flow of Des Moines River below Raccoon River at Des Moines increased slightly (seasonal) but remained below median.

In Nebraska, the statewide pattern of streamflow also was quite variable in June. Minor flooding occurred along small streams in some southeastern counties. In northeastern Nebraska, monthly mean flow of Elkhorn River at Waterloo decreased sharply, contrary to the normal seasonal pattern of increasing flow, and was only 52 percent of median. (See graph.) In the Republican River and Lodgepole Creek basins, in the southwestern part of the State, mean flows were reported to be less than normal.



Monthly mean discharge of Elkhorn River at Waterloo, Nebr.
(Drainage area, 6,900 sq mi; 17,900 sq km)

In South Dakota, where streamflows normally increase in June, the observed flows were less than those of May, contrary to the seasonal pattern. For example, in the central part of the State, mean flow of Bad River near Fort Pierre was 74 percent less than in May and in the below-normal range, in contrast to a normal seasonal increase of about 400 percent. In eastern South Dakota, mean flow of Big Sioux River at Akron, Iowa, on the South Dakota-Iowa border, decreased 20 percent from May, in contrast to a normal seasonal increase of 32 percent.

In southwestern North Dakota, where mean flows of Cannonball River at Breien during March, April, and May were above the normal range and about 7 to 14 times the respective median flows, mean discharge decreased sharply in June, contrary to the normal seasonal pattern of increasing flow, and was in the normal range. In the eastern part of the State, monthly mean discharge of Red River of the North at Grand Forks also decreased sharply and was only 70 percent of the median flow for June.

In southeastern Saskatchewan, monthly mean discharge of Qu'Appelle River near Lumsden continued to decrease seasonally, remained in the below-normal range, and was only 50 percent of the median flow for June.

In southern Manitoba, mean flow of Waterhen River below Waterhen Lake decreased, contrary to the normal seasonal pattern of increasing flow in June, was less than median but was within the normal range. The level of Lake Winnipeg at Gimli averaged 714.03 feet above mean sea level for the month, 0.48 foot higher than last month, 0.10 foot higher than the long-term average for June, and 2.27 feet higher than a year ago. The record of Lake Winnipeg levels began in May 1913 at Winnipeg Beach.

Ground-water levels in North Dakota declined slightly but were near average in the west, and declined and were below average in the east. Levels in Nebraska generally declined statewide but continued above average. In Iowa, levels in shallow water-table wells generally declined except in the north-central part of the State. They generally continued above average except in the southwest corner where precipitation has been minimal. Levels in Kansas generally declined slightly except in the key well in Sedgwick County near Wichita. Another record low for the month was recorded in the well at Colby, in Thomas County, in the northwest Kansas high plains. In the rice-growing area of east-central Arkansas, the water level in the shallow Quaternary aquifer declined slightly, but was in the same range that has prevailed since 1961. The level in the deep aquifer—the Sparta Sand—declined about 46 feet, and was about 24 feet below average. In the industrial aquifer of central and south Arkansas, the level in the key well at Pine Bluff declined slightly and was about 4½ feet below average——setting a new June low. At El Dorado the

level was about 4½ feet lower than last month, and was about 4.0 feet below average. In Louisiana, record lows for June occurred in wells in the Chicot and Evangeline aquifers near Opelousas, and in the Evangeline near Eunice. Levels in most aquifers in southeastern Louisiana declined, but levels rose in the intermediate sands and in the shallow upland terrace deposits. Levels in wells in the terrace and alluvial aquifers of the northern and central parts of the State continued their seasonal decline. Regional levels in the Miocene aquifer and the Sparta sand continued to decline. In Texas, levels in key wells in the Edwards Limestone declined but were above average at Austin, and declined and were below average at San Antonio. Levels in wells in the Evangeline aquifer at Houston rose but continued below average; levels in the bolson deposits at El Paso declined and continued below average. New alltime lows were reached in the key wells at El Paso and in the Ogallala Formation at Plainview in the Texas Panhandle.

WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

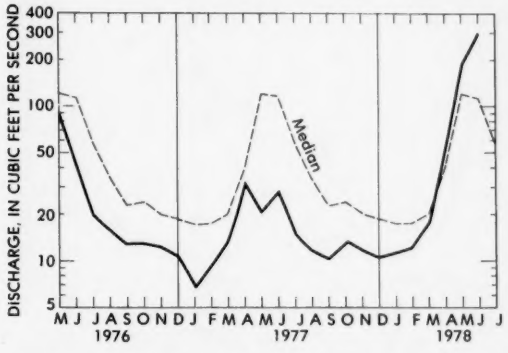
Streamflow generally increased in most of the region but decreased seasonally in Arizona and Oregon, and was variable in California, New Mexico, and Washington. Monthly mean flows remained in the above-normal range in parts of California and Oregon, and increased into that range in parts of Colorado, Idaho, New Mexico, Utah, and Wyoming. Flows persisted in the below-normal range in parts of British Columbia and Oregon, and decreased into that range in part of Colorado. Decreasing flows in parts of Colorado and Idaho, and increasing flows in parts of California, New Mexico, Utah, and Washington, were contrary to the normal seasonal pattern of monthly mean flows in those areas.

Ground-water levels declined in Washington, southern California, and Arizona, and rose in Montana; mixed trends prevailed elsewhere in the region. Levels were below average in much of the region; they were average in Montana and mixed in Idaho, southern California and Nevada. New June lows occurred in Idaho, Nevada, Arizona, and New Mexico, and a new June high was recorded in southern California. A new alltime low was reached in Idaho.

In Wyoming, monthly mean flows increased seasonally and were above the normal range except in the central and eastern parts of the State, where they were in the normal range. In extreme north-central Wyoming, the monthly mean discharge of 1,504 cfs in Tongue River near Dayton (drainage area, 204 square miles) was highest for any month in 49 years of record. The daily mean discharge of 2,360 cfs on June 10 was only 9 percent less than the maximum daily mean of record for any month. In the extreme south-central part of the State, mean flow of North Platte River above Seminoe Reservoir, near Sinclair, increased sharply, as a result of high rates of runoff near midmonth, and was above the normal range. In the extreme western part of the State, mean flow of Snake River also increased sharply and was above the normal range.

In Colorado, monthly mean flows of Roaring Fork River at Glenwood Springs and of Yampa River at Steamboat Springs, west of the Continental Divide, increased sharply and were in the above-normal range. East of the Divide, mean flow of Bear Creek at Morrison decreased, contrary to the normal seasonal pattern of increasing flows in June, was below the normal range, and was only 40 percent of median. In the southern part of the State, flows increased and remained within the normal range.

In southwestern Utah, monthly mean flow of Beaver River near Beaver increased sharply, contrary to the normal seasonal pattern of decreasing flow in June, and was above the normal range for the first time since March 1974. (See graph.) Monthly mean discharges were



Monthly mean discharge of Beaver River near Beaver, Utah (Drainage area, 90.7 sq mi; 235 sq km)

below the normal range at this station for 24 consecutive months, from March 1976 through February 1978. In the northern part of the State, flows increased seasonally in Big Cottonwood Creek near Salt Lake City, Weber River near Oakley, and Green River near Green River, and were above the normal range at all 3 stations. In eastern Utah, and the adjacent area of western Colorado, mean flow of Colorado River, as measured near Cisco, Utah, also increased seasonally and was in the above-normal range.

In Arizona and New Mexico, monthly mean flows generally decreased seasonally and were in the normal range. In northeastern Arizona, no flow was observed in Little Colorado River near Cameron during June, which is the normal condition for the month. In northern New Mexico, monthly mean flow in Rio Grande below Taos Junction Bridge, near Taos, increased in June, contrary to the normal seasonal pattern of flow at that site. In the southeastern part of that State, mean flow in Delaware River near Red Bluff increased sharply, was 22½ times the median flow for June, and was above the normal range.

In northern Nevada, mean flow of Humboldt River at Palisade increased seasonally, as a result of runoff from melting snow, but remained below median. Elsewhere in the State, flows were reported to be near or above average.

In southern California, monthly mean flow of Arroyo Seco near Pasadena remained in the above-normal range for the 6th consecutive month, partly as a result of high carryover flow from May. In the southern part of the Sierra Nevada, mean flow of Kings River above North Fork, near Trimmer, increased, was 2½ times the median flow for June, and was above the normal range. Cumulative runoff at this station for the first 9 months of the 1978 water year was 187 percent of median. In the central part of the Sierra Nevada, mean flow of North Fork American River at North Fork Dam decreased seasonally and was in the normal range. Cumulative runoff at this site for the first 9 months of the 1978 water year was 134 percent of median, in contrast to the cumulative runoff of 21 percent at the end of the first 2 months. In the east-central part of the State, mean flow of West Walker River below Little Walker River, near Coleville increased seasonally, was 1½ times the June median, and was above the normal range. Combined monthend storage in 10 of the major reservoirs in northern California was 107 percent of average and was more than 2½ times that of a year ago.

In southwestern Oregon, monthly mean flow of Umpqua River near Elkton continued to decrease seasonally, remained in the below-normal range for the 4th consecutive month, and was only 66 percent of median. In the adjacent basin of Willamette River, mean flow at Salem also decreased seasonally, was below the normal range, and was only 69 percent of median. In the northwestern corner of the State, monthly mean discharge of Wilson River near Tillamook decreased seasonally but remained in the above-normal range.

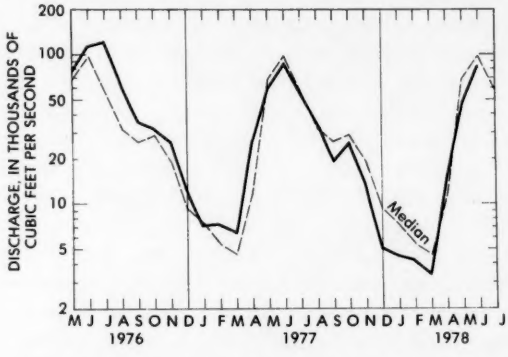
In northern Washington, monthly mean flow of Skykomish River near Gold Bar increased and was in the normal range, in contrast to the 2 preceding months of mean discharge in the below-normal range. In the western part of the State, mean flow in Chehalis River near Grand Mound decreased seasonally, remained in the normal range, and was greater than median. In the eastern part of the State, monthly mean discharge of Spokane River at Spokane also decreased seasonally and was in the normal range, but was less than median.

In eastern Idaho, mean flow of Snake River near Heise increased seasonally and was above the normal range. In the southwestern part of the State, monthly flow of Snake River at Weiser decreased seasonally and remained in the normal range but was only 74 percent of median. Flows of Coeur d'Alene, Clearwater, Boise, and Salmon Rivers also were in the normal range. Reservoir storage at monthend was slightly above average.

In Montana, where severe flooding occurred in the southeastern part of the State in May, monthly mean flows generally increased seasonally but were in the normal range and only slightly greater than median. In north-central Montana, mean flow of Marias River near Shelby decreased but remained in the normal range and was 103 percent of median.

In Alberta, monthly mean flows of Athabasca River at Hinton and Bow River at Banff increased seasonally but remained within the normal range and were slightly less than median.

In southern British Columbia, monthly mean flow of Fraser River at Hope increased seasonally but remained in the below-normal range. Similarly, in the west-central part of the Province, mean flow of Skeena River at Usk increased seasonally, was less than median, and was in the below-normal range for the 7th time in the past 8 months. (See graph.)



Monthly mean discharge of Skeena River at Usk, British Columbia (Drainage area, 16,300 sq mi; 42,217 sq km)

Ground-water levels in Washington declined and were below average in the key well in the Spokane Valley in the eastern part of the State and in the western well near

Sumas. In Idaho, the level in the well penetrating the sand and gravel aquifer in the Boise Valley rose for the second consecutive month and was above average. Levels in key wells in the Snake River Plain aquifer declined, and a new record low was reached near Atomic City in 29 years of record. Despite mixed trends, new lows for June occurred in the Rupert-Minidoka area and west to Gooding. The level in the key well in the alluvial aquifer underlying the Rathdrum Prairie, northern Idaho, rose slightly for the third consecutive month but was nearly 10 feet below average. In Montana, levels generally rose and were about average for June. In southern California, levels in selected observation wells in Santa Barbara County and Orange County declined. The level of the well in Cuyama Valley in Santa Barbara County, however, was the highest for June in 28 years but below the new alltime record high in May. The level rose but continued below average in the key well at Baldwin Park in Los Angeles County. In Nevada, the level in the Las Vegas key well declined more than 6 feet, reaching a new low for June. The level rose and was above average in the Paradise Valley well, and rose but was below average at Truckee Meadows. The level in the well in Steptoe Valley declined ½ foot but continued nearly 2 feet above average. Levels declined in Utah except in the Blanding area, and continued below average statewide. In Arizona, levels declined in all index wells; a new low for June was measured in one of the wells. In New Mexico, levels in the observation wells continued below average; the level in the Dayton well in the Roswell basin reached a new low for June. Levels in the Hrna well in the Deming area, and in the Berrendo-Smith well, near Roswell, showed significant rises following heavy rains that allowed a decrease in pumping for irrigation.

ALASKA

Streamflow generally increased seasonally but was less than median throughout most of the State as a result of a less-than-normal snowpack and below-normal precipitation during May and the first part of June. Monthly mean discharge in Chena River at Fairbanks, in the central part of the State, remained in the below-normal range and was the second lowest monthly mean flow in 30 years of record. Also in central Alaska, the monthly mean discharge of 28,240 cfs and the daily mean discharge of 21,800 cfs on the 1st at Tanana River at Nenana (drainage area, 25,600 square miles) were lowest for June in 17 years of record.

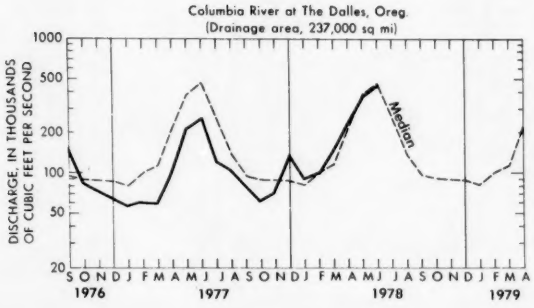
Ground-water levels representative of the confined aquifer in the Anchorage area dropped 2 to 3 feet in many observation wells. A new low in seven years of record occurred in one well in south Anchorage. Levels were stable in the Ship Creek alluvial fan, and elsewhere the shallow water table declined slightly.

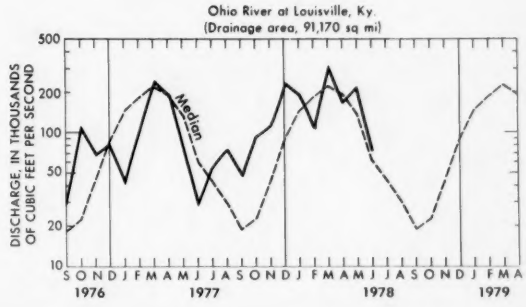
HAWAII

Streamflow increased sharply on the islands of Kauai and Hawaii and decreased seasonally on the islands of Maui and Oahu. Monthly mean flows were above the normal range at index stations throughout the State as a result of above-normal precipitation during the month. In East Branch of North Fork Wailua River near Lihue, Kauai (drainage area, 6.27 square miles), the monthly mean discharge of 80.5 cfs was highest for the month in 63 years of record. Prior to June, monthly mean flows at index stations in the State had been in, or below, the normal range for at least 9 consecutive months.

On Guam, Mariana Islands, monthly mean discharge at Ylig River near Yona increased sharply to 144 percent of median. Mean flows at that site have been below the normal range in 4 of the past 6 months.

HYDROGRAPHS OF TWO LARGE RIVERS





USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF JUNE 1978

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of May 1978	End of June 1978	End of June 1977	Average for end of June	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	80	73	85	70	226,300 (a)
QUEBEC					
Allard (P)	91	89	93	83	280,600 ac-ft
Gouin (P)	69	76	80	64	6,954,000 ac-ft
MAINE					
Seven reservoir systems (MP)	96	93	100	87	178,500 mcf
NEW HAMPSHIRE					
First Connecticut Lake (P)	91	92	93	90	3,330 mcf
Lake Francis (FPR)	79	91	90	87	4,326 mcf
Lake Winnipesaukee (PR)	107	101	105	96	7,200 mcf
VERMONT					
Harriman (P)	91	83	82	83	5,060 mcf
Somerset (P)	82	80	82	87	2,500 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	95	89	84	88	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	97	89	87	92	34,270 mcf
Indian Lake (FMP)	108	98	97	101	4,500 mcf
New York City reservoir system (MW)	101	98	94	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	102	96	87	89	27,730 mg
PENNSYLVANIA					
Allegheny (FPR)	52	49	48	49	51,400 mcf
Pymatuning (FMR)	104	100	95	97	8,191 mcf
Raystown Lake (FR)	67	68	66	55	33,190 mcf
Lake Wallenpaupack (PR)	87	82	84	80	6,875 mcf
MARYLAND					
Baltimore municipal system (M)	100	98	90	93	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	93	92	93	90	12,580 mcf
Narrows (Badin Lake) (P)	97	98	92	98	5,617 mcf
High Rock Lake (P)	91	84	86	78	10,230 mcf
SOUTH CAROLINA					
Lake Murray (P)	94	90	89	79	70,300 mcf
Lakes Marion and Moultrie (P)	86	85	79	74	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	79	75	71	73	75,360 mcf
GEORGIA					
Burton (PR)	99	99	95	91	104,000 ac-ft
Sinclair (MPR)	93	86	86	92	214,000 ac-ft
Lake Sidney Lanier (FMPR)	65	63	64	63	1,686,000 ac-ft
ALABAMA					
Lake Martin (P)	98	98	92	91	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	66	66	58	61	1,156,000 cfsd
Douglas Lake (FPR)	68	70	63	67	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	76	76	88	81	510,300 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	67	69	61	67	1,452,000 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	69	70	81	83	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	84	96	81	87	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	69	87	50	82	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	33	37	26	40	1,640,000 ac-ft
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	86	96	82	.....	22,640,000 ac-ft
SOUTH DAKOTA					
Angostura (I)	101	100	66	90	127,600 ac-ft
Bell Fourche (I)	101	99	47	70	185,200 ac-ft
Lake Francis Case (FIP)	84	82	76	84	4,834,000 ac-ft
Lake Oahe (FIP)	98	97	82	.....	22,530,000 ac-ft
MIDCONTINENT REGION—Continued					
SOUTH DAKOTA—Continued					
Lake Sharpe (FIP)	104	102	103	99	1,725,000 ac-ft
Lewis and Clarke Lake (FIP)	82	77	89	88	477,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	76	74	78	80	1,948,000 ac-ft
OKLAHOMA					
Eufaula (FPR)	105	103	98	104	2,378,000 ac-ft
Keystone (FPR)	103	108	101	103	661,000 ac-ft
Tenkiller Ferry (FPR)	107	113	100	100	628,200 ac-ft
Lake Altus (FIMR)	90	99	100	68	134,500 ac-ft
Lake O'The Cherokees (FPR)	100	99	109	95	1,492,000 ac-ft
OKLAHOMA—TEXAS					
Lake Texoma (FMPRW)	85	100	101	101	2,722,000 ac-ft
TEXAS					
Bridgeport (IMW)	62	61	98	52	386,400 ac-ft
Canyon (FMR)	94	95	99	74	385,600 ac-ft
International Amistad (FIMPW)	91	86	100	74	3,497,000 ac-ft
International Falcon (FIMPW)	63	69	100	64	2,667,000 ac-ft
Livingston (IMW)	98	95	100	81	1,788,000 ac-ft
Possum Kingdom (IMPRW)	82	86	94	106	569,400 ac-ft
Red Bluff (PI)	7	10	15	27	307,000 ac-ft
Toledo Bend (P)	96	93	94	89	4,472,000 ac-ft
Twin Buttes (FIM)	74	74	96	22	177,800 ac-ft
Lake Kemp (IMW)	56	59	93	95	268,000 ac-ft
Lake Meredith (FMW)	33	40	37	39	821,300 ac-ft
Lake Travis (FIMPRW)	60	57	98	81	1,144,000 ac-ft
THE WEST					
WASHINGTON					
Ross (PR)	66	99	58	89	1,052,000 ac-ft
Franklin D. Roosevelt Lake (IP)	41	87	80	98	5,232,000 ac-ft
Lake Chelan (PR)	70	96	85	96	676,100 ac-ft
Lake Cushman	93	102	73	98	359,500 ac-ft
Lake Merwin (P)	101	102	108	105	246,000 ac-ft
IDAHO					
Boise River (4 reservoirs) (FIP)	73	82	47	90	1,235,000 ac-ft
Coeur d'Alene Lake (P)	109	100	102	83	238,500 ac-ft
Pend Oreille Lake (FP)	71	99	90	98	1,561,000 ac-ft
IDAHO—WYOMING					
Upper Snake River (8 reservoirs) (MP)	76	90	53	84	4,401,000 ac-ft
WYOMING					
Boysen (FIP)	61	96	70	88	802,000 ac-ft
Buffalo Bill (IP)	57	102	74	103	421,300 ac-ft
Keyhole (F)	104	86	71	48	199,900 ac-ft
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	56	69	62	63	3,056,000 ac-ft
COLORADO					
John Martin (FIR)	0	0	0	19	364,400 ac-ft
Taylor Park (IR)	32	66	64	96	106,200 ac-ft
Colorado–Big Thompson project (I)	30	56	48	75	722,600 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	64	72	70	.....	31,280,000 ac-ft
UTAH—IDAHO					
Bear Lake (IPR)	67	72	67	69	1,421,000 ac-ft
CALIFORNIA					
Folsom (FIP)	88	94	26	89	1,000,000 ac-ft
Hetch Hetchy (MP)	58	88	41	81	360,400 ac-ft
Isabella (FIR)	64	87	15	44	551,800 ac-ft
Pine Flat (FI)	54	86	35	68	1,014,000 ac-ft
Clair Engle Lake (Lewiston) (P)	70	79	32	89	2,438,000 ac-ft
Lake Almanor (P)	88	96	65	63	1,036,000 ac-ft
Lake Berryessa (FIMW)	82	79	55	84	1,600,000 ac-ft
Millerton Lake (FI)	32	77	46	82	503,200 ac-ft
Shasta Lake (FIPR)	102	99	22	86	4,377,000 ac-ft
CALIFORNIA—NEVADA					
Lake Tahoe (IPR)	26	34	19	74	744,600 ac-ft
NEVADA					
Rye Patch (I)	46	47	52	88	157,200 ac-ft
ARIZONA—NEVADA					
Lake Mead and Lake Mohave (FIMP)	80	80	76	72	27,970,000 ac ft
ARIZONA					
San Carlos (IP)	22	18	0	14	1,073,000 ac-ft
Salt and Verde River system (IMPR)	94	87	36	43	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	26	33	23	76	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	12	12	10	29	2,539,000 ac-ft

[a] Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

Provisional data; subject to revision

DISSOLVED SOLIDS AND WATER TEMPERATURES FOR JUNE AT DOWNSTREAM SITES ON SIX LARGE RIVERS

Station number	Station name	June data of following calendar years	Stream discharge during month	Dissolved-solids concentration during month[a]		Dissolved-solids discharge during month[a]			Water temperature during month[b]		
			Mean (cfs)	Minimum (mg/L)	Maximum (mg/L)	Mean	Minimum	Maximum	Mean, in °C	Minimum, in °C	Maximum, in °C
						(tons per day)					
	NORTHEAST										
01463500	Delaware River at	*1978	9,314	95	122	1,750	1,510	1,980	23.5	23.0	25.0
	Trenton, N.J.	1945–77	9,482	60	143	.....	495	22,100	.....	13.5	34.0
	(Morrisville, Pa.)	(Extreme yr)		(1945)	(1965)		(1965)	(1973)			
			[c]6,992								
04264331	St. Lawrence River at	1978	308,000	166	167	138,000	136,000	140,000	15.5	13.0	17.0
	Cornwall, Ontario, near	1976–77	305,500	166	169	138,000	110,000	159,000	14.5	11.5	17.5
	Massena, N.Y.	(Extreme yr)		(1976, 1977)	(1976)		(1977)	(1976)			
	median streamflow at Ogdensburg, N.Y.		[c]261,500								
	SOUTHEAST										
07289000	Mississippi River at	1978	641,400	230	299	45,300	34,400	62,600	28.5	24.5	31.0
	Vicksburg, Miss.	1976–77	349,600	219	316	262,000	171,000	429,000	23.0	17.0	29.0
		(Extreme yr)		(1977)	(1976)		(1977)	(1976)			
			[c]591,400								
	WESTERN GREAT LAKES REGION										
03612500	Ohio River at lock and dam	1978	170,400	200	232	.....	63,000	180,000	.....	22.0	30.5
	53, near Grand Chain, Ill.	1955–77	200,900	111	300	.....	27,000	328,000	.....	16.5	30.0
	(25 miles west of Paducah,	(Extreme yr)		(1974)	(1970)		(1977)	(1968)			
	Ky.; streamflow station		[c]174,600								
	at Metropolis, Ill.)										
	MIDCONTINENT										
06934500	Missouri River at Hermann,	1978	88,800	260	371	76,300	60,800	118,000	24.5	22.0	28.0
	Mo. (60 miles west of St.	1976–77	75,900	207	418	62,100	44,000	105,000	24.5	21.0	27.0
	Louis, Mo.)	(Extreme yr)		(1977)	(1977)		(1977)	(1977)			
			[c]109,600								
	WEST										
14128910	Columbia River at	1978	238,800	66	82	48,800	35,400	64,300	15.5	14.0	16.5
	Warrendale, Oreg.	1976–77	204,900	61	107	41,400	19,100	57,900	16.0	12.5	19.5
	(streamflow station	(Extreme yr)		(1976)	(1977)		(1977)	(1976)			
	at The Dalles, Oreg.)		[c]454,200								

[a]Dissolved-solids concentrations when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b]To convert °C to °F: [(1.8 X °C) + 32] = °F.
[c]Median of monthly values for 30-year reference period, water years 1941–70, for comparison with data for current month.
*Dissolved solids and water temperatures are for 9 days only (June 22–30).

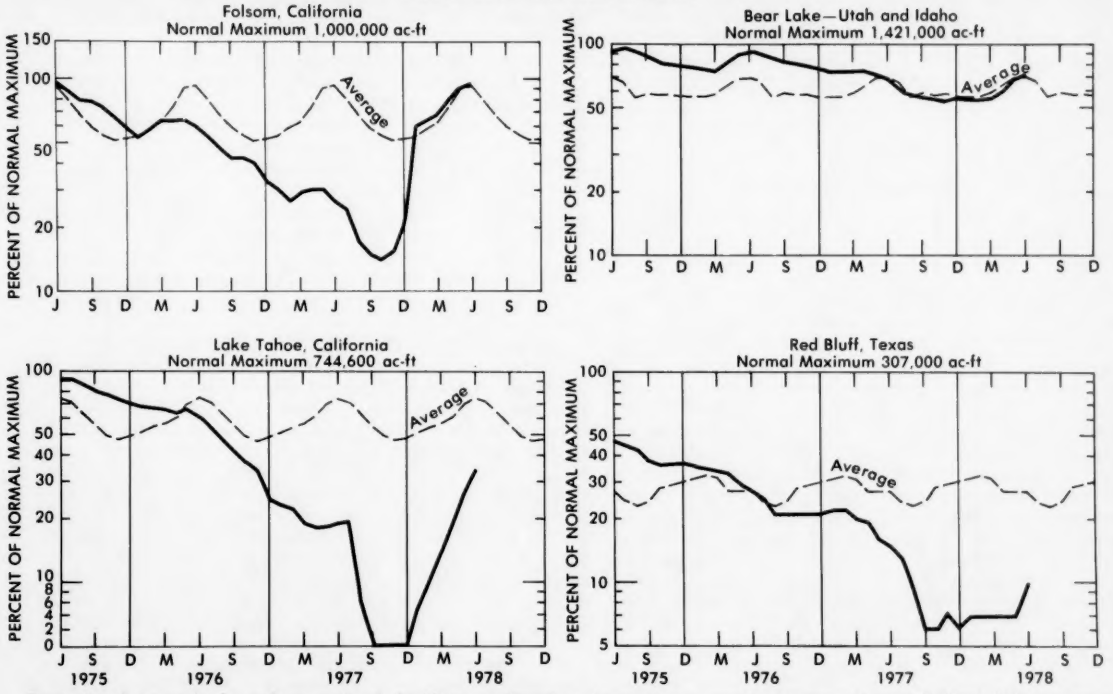
Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING JUNE 1978

Station number*	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	June 1978					
				Monthly discharge (cfs)	Percent of median monthly discharge, 1941–70	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine	5,690	9,397	9,591	102	-80	5,800	3,750	30
1–3185	Hudson River at Hadley, N.Y	1,664	2,791	2,023	87	-71	1,090	700	30
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,450	3,435	112	-48	.....	.....	.....
1–4635	Delaware River at Trenton, N.J	6,780	11,360	9,296	133	-55	5,940	3,940	26
1–5705	Susquehanna River at Harrisburg, Pa	24,100	33,670	24,900	108	-66	16,000	10,300	29
1–6465	Potomac River near Washington, D.C	11,560	[1]10,640	6,720	91	-78	4,220	2,730	30
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C	4,810	4,847	4,459	230	-71	3,850	2,490	30
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	7,710	131	-62	8,350	5,400	28
2–2260	Altamaha River at Doctortown, Ga	13,600	13,380	6,777	79	-65	4,520	2,920	30
2–3205	Suwannee River at Branford, Fla	7,740	6,775	6,540	132	-31	5,620	3,630	30
2–3580	Apalachicola River at Chattahoochee, Fla	17,200	21,690	19,000	115	-50	12,800	8,270	30
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala	15,400	21,700	17,720	277	-63	6,600	4,270	27
2–4895	Pearl River near Bogalusa, La	6,630	8,533	5,834	163	-74	3,600	2,300	30
3–0495	Allegheny River at Natrona, Pa	11,410	[1]18,700	10,590	93	-68	7,790	5,030	26
3–0850	Monongahela River at Braddock, Pa	7,337	[1]11,950	7,150	113	-69	2,750	1,780	26
3–1930	Kanawha River at Kanawha Falls, W.Va	8,367	12,370	6,602	98	-68	6,060	3,920	24
3–2345	Scioto River at Higby, Ohio	5,131	4,337	3,270	160	-52	2,010	1,300	27
3–2945	Ohio River at Louisville, Ky[2]	91,170	110,600	73,170	120	-66	64,000	41,400	26
3–3775	Wabash River at Mount Carmel, Ill	28,600	26,310	19,940	94	-65	12,400	8,010	30
3–4690	French Broad River below Douglas Dam, Tenn	4,543	[1]6,528	5,371	115	-38	.....	.....	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis[2]	6,150	4,142	3,524	93	-49	.....	.....	.....
02MC002 (4–2643.31)	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y[3]	299,000	239,100	308,100	118	-2	304,000	196,000	30
050115	St. Maurice River at Grand Mere, Quebec	16,300	24,900	25,600	85	-69	21,700	14,000	29
5–0825	Red River of the North at Grand Forks, N. Dak	30,100	2,439	3,190	70	-35	2,600	1,680	30
5–3300	Minnesota River near Jordan, Minn	16,200	3,306	7,420	135	+2	9,880	6,390	23
5–3310	Mississippi River at St. Paul, Minn	36,800	[1]10,230	20,420	115	+7	21,400	13,800	23
5–3655	Chippewa River at Chippewa Falls, Wis	5,600	5,062	6,075	109	+143	.....	.....	.....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	11,304	115	+23	.....	.....	.....
5–4465	Rock River near Joslin, Ill	9,520	5,288	8,000	146	-25	7,400	4,780	30
5–4745	Mississippi River at Keokuk, Iowa	119,000	61,210	87,300	101	-14	119,500	77,200	30
5–4855	Des Moines River below Raccoon River at Des Moines, Iowa	9,879	3,796	4,852	67	+13	7,000	4,500	30
6–2145	Yellowstone River at Billings, Mont	11,796	6,754	30,640	116	+90	32,000	20,700	30
6–9345	Missouri River at Hermann, Mo	528,200	78,480	89,550	82	-37	83,000	53,600	26
7–2890	Mississippi River at Vicksburg, Miss[4]	1,144,500	552,700	641,400	108	-34	525,000	339,000	30
7–3310	Washita River near Durwood, Okla	7,202	1,379	4,776	282	+52	700	450	30
8–2765	Rio Grande below Taos Junction Bridge, near Taos, N. Mex	9,730	732	832	110	+2	670	430	30
9–3150	Green River at Green River, Utah	40,600	6,369	27,322	147	+101	21,200	13,700	30
11–4255	Sacramento River at Verona, Calif	21,257	18,370	9,880	93	-48	9,750	6,300	27
13–2690	Snake River at Weiser, Idaho	69,200	17,670	18,240	74	-30	15,400	9,950	27
13–3170	Salmon River at White Bird, Idaho	13,550	11,060	46,900	122	+53	36,950	23,900	28
13–3425	Clearwater River at Spalding, Idaho	9,570	15,320	36,310	99	+18	27,200	17,600	28
14–1057	Columbia River at The Dalles, Oreg[5]	237,000	194,000	451,000	95	+22	.....	.....	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	9,282	69	-52	7,350	4,750	26–30
15–5155	Tanana River at Nenana, Alaska	25,600	24,040	28,237	60	+17	27,500	17,800	30
8MF005	Fraser River at Hope, British Columbia	83,800	95,300	199,000	81	+47	189,000	122,000	29

[1] Adjusted.
[2] Records furnished by Corps of Engineers.
[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[5] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.
*The U.S. station numbers as listed in this table are in a shortened form previously in use, and used here for simplicity of tabular and map presentation. The full, correct number contains 8 digits and no punctuation marks. For example, the correct form for station number 1–3185 is 01318500.

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS, JUNE 1975 TO JUNE 1978



Contents of reservoirs in various parts of the West continued to increase as a result of snowmelt runoff. Much below-average contents characterized Red Bluff Reservoir in Texas. (See graph above.)

WATER RESOURCES REVIEW

June 1978

Based on reports from the Canadian and U.S. field offices; completed July 17, 1978

TECHNICAL STAFF

Allen Sinnott, Editor
Carroll W. Saboe, Associate Editor
Herman D. Brice
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John C. Kammerer
Gwendolyn V. Butler
Ada E. Derrenbacker

COPY PREPARATION

Lois C. Fleshmon
Sharon L. Peterson
Donna R. Johnson
Stephanie F. Michie

GRAPHICS

Frances B. Davison
Carolyn L. Moss
Leslie J. Robinson
Joan M. Rubin

EXPLANATION OF DATA

Cover map shows generalized pattern of streamflow for June based on 20 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for June 1978 is compared with flow for June in the 30-year reference period 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for December is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being *within the normal range.* In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the June flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of June. Water level in each key observation well is compared with average level for the end of June determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels,* unless described otherwise, are from the end of June to the end of July.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

The accompanying abstract and map are from the report, *Hydrogeology of the karst of Puerto Rico*, by Ennio V. Giusti: U.S. Geological Survey Professional Paper 1012, 68 pages, 1978. This report may be purchased for $2.10 from the Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, VA 22202 (check or money order payable to U.S. Geological Survey); or from Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 (payable to Superintendent of Documents).

ABSTRACT

About one-fifth of Puerto Rico (fig. 1) is covered by a tropical karst formed on a series of six limestone formations ranging in age from middle-Oligocene to middle Miocene. These formations strike east to west and crop out over the north coast of the island. Structurally, the rocks form a simple wedge abutting southward against a mountain chain of volcanic origin and thickening northward to about 1,400 meters by the seashore. All stages of karstification are present: from the incipient, found at the western end of the belt to the residual, found at the eastern end. Maximum development of sinkholes occurs on the Aguada Limestone and upper part of the Aymamón Limestone. These formations have a $CaCO_3$ content range from about 85 to 95 percent. The semi-impermeable Cibao Formation has developed a fluvial drainage. An analysis of stream channel orientations indicates that the present topographic drainage oriented toward the northeast is superimposed on a former drainage system oriented toward the northwest. Transition from the northwestern to the northeastern drainage orientation is ascribed to Pleistocene eastward tilting of the Puerto Rican platform. This tilt is thought to have affected the subterranean drainage pattern as well, so that springs are found mainly on the western wall of northward-oriented valleys. Estimates of the water budget indicate that the karstic stream basins behave on an annual basis much as other stream basins that are not on limestone terrane. Average incoming solar radiation (expressed as evaporated water) and rainfall (2,900 mm and 1,750 mm, respectively) result in an evapotranspiration of about 1,100 mm (millimeters) annually and a discharge of 650 mm. This discharge is accommodated fluvially in areas underlain by the Cibao Formation and by the lower part of the Lares Limestone and subterraneally through the karst elsewhere.

Base flow of streams in limestone in Puerto Rico is less than in streams in volcanic terrane, owing to fast disposal of rainfall through networks of subterranean solution channels. Ground water is found under water-table conditions in the Aymamón and Aguada and under artesian conditions in parts of the Cibao and the Lares. The unconfined ground-water discharges along a strip near the shoreline into swamps and lagoons; the artesian water discharges through a submarine face an unknown distance from the coast and possibly, in part, along a presumed fault near the coast. In the western part of the belt, ground water discharges through the sea bottom, possibly as springs. Permeability is found to decrease exponentially with stratigraphic depth.

Except for lake waters resting on terra rossa, most waters of the limestone belt are saturated or supersaturated with respect to calcite, and as much as 86 percent of the solution is computed to arise mainly from enrichment of rainwater with CO_2 in the soil from the decomposition of organic acids. The denudation rate of the limestone belt through solution is computed as 0.070 mm per year with some evidence that abrasion may increase the denudation rate locally by as much as 40 percent. Calculations based on a projected initial limestone surface and the computed solution rate reveal that the limestone belt emerged from the sea about 4 million years ago and that the eastward tilt of the Puerto Rican platform, reported in the literature, occurred about 1 million years ago. Of the factors pertinent to karst development, aquifer permeability, both vertical and lateral, and primary rock porosity are thought to be the basic control for the existence and morphology of the karst. Assuming sufficiently pure limestone, climate is considered of secondary importance.

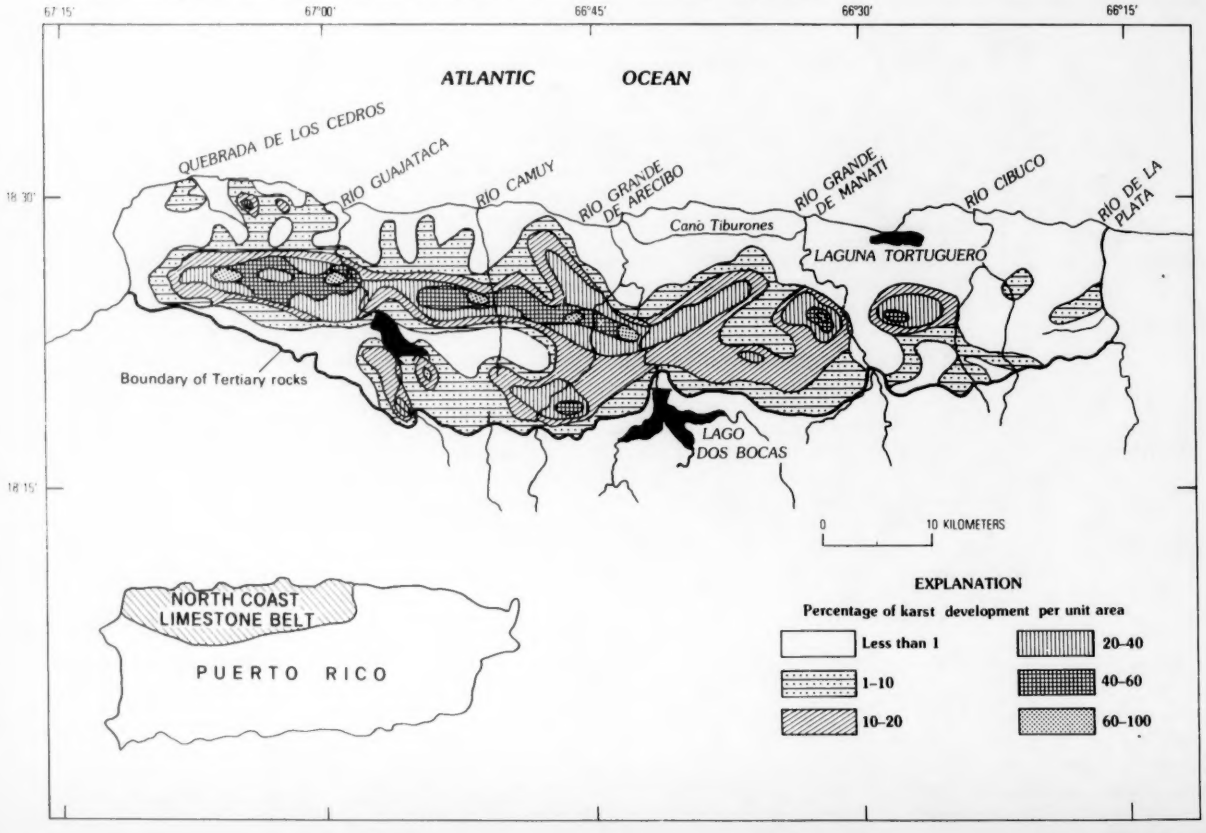

Figure 1.—Karst development of the north coast limestone belt.

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